

## SOME FURTHER OBSERVATIONS ON THE REARING OF *CERATODUS*.

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(Communicated by I. M. Mackerras, M.B., B.Sc.)

(Two Text-figures.)

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These observations are supplementary to my paper read before the Society on 27th June, 1928 (These PROCEEDINGS, liii, p. 315). It had been shown that the larval *Ceratodus* lie out of the water on the mud-banks at intervals during the day and that, if prevented from doing so (due to the water being too deep), they die before reaching the age of ten weeks.

The suggestion made to use small vessels, such as enamelled pie-dishes, proved to be tedious when practised on a large scale, as it entailed a lot of work in adding water to replace that lost through evaporation. It was also found almost impossible to keep so small a body of water sufficiently cool in very hot weather. Subsequently a hatchery was erected which has given the best results hitherto obtained. Sufficient embryological material was secured to satisfy all the workers in Europe, one of whom wrote to me: "We have all the stages of *Ceratodus* so it does not matter now if the animal becomes extinct."

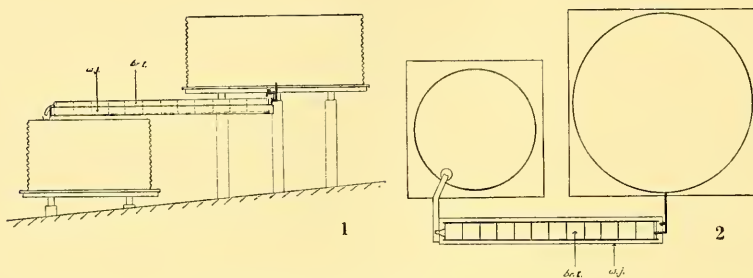
The hatchery (Text-figs. 1-2) consists of a 2,000-gallon tank, which delivers river water into the rearing chambers and into the water-jacket which surrounds them, the overflow being collected in a 1,000-gallon tank, whence it is returned to the upper tank by means of a No. 3 semi-rotary pump.

The upper tank is made of corrugated galvanized iron. It is circular, 10 feet in diameter by 4 feet high. From the bottom corrugation, a  $\frac{3}{4}$ -inch delivery pipe is led off, which connects through a T-piece with two brass stopcocks. One of these is  $\frac{1}{2}$  inch in diameter and feeds into the narrow compartment at the right-hand end of the breeding chambers, the other is  $\frac{3}{4}$  inch in diameter and feeds into the water-jacket.

The breeding chambers are built of 1-inch pine, and consist of a trough 12 feet 3 inches long by 12 inches wide by 9 inches deep, all measurements over all, divided by wooden partitions into twelve equal chambers, with a small chamber 1 inch in diameter at the right-hand or upper end. All parts must be so put together that the whole forms a solid, water-tight job. The right-hand end of the trough is solid, but all the partitions are provided with slots 8 inches by 1 inch, situated 4 inches above the bottom, and covered on the right-hand or upper side with perforated zinc. The left-hand or lower end of the trough is slotted to take an overflow pipe, which is protected by gauze and delivers into the lower tank. The trough is fitted with a 1-inch cleat which raises the right hand end and ensures a flow of water through the chambers. A gauze cover, made in three sections, is provided to protect the open top of the trough.

The water-jacket is of galvanized sheet-iron, 12 feet 9 inches long by 1 foot 6 inches wide by 6 inches deep. The trough is held in place in it by six galvanized iron straps. The jacket is set dead level and provides a water space 3 inches in diameter all round the trough.

The lower tank is of corrugated galvanized iron and is circular, 7 feet in diameter by 4 feet high. It is so placed that the overflow from the breeding chambers delivers into its top. A 1½-inch pipe is taken off from the lowest corrugation. This connects with the pump, which returns the water to the upper tank.



Text-figures 1-2. *Ceratodus* hatchery.  
1.—Side elevation. 2.—Ground plan. *w.j.*, water jacket; *br. t.*, breeding tank.

A mud-bank was arranged in each of the twelve compartments and a continuous trickle of water was maintained through the whole system. Twenty to thirty larval *Ceratodus*, two weeks old, were placed in each compartment.

Rolled oats, dried egg, *Euchytra* worms, duck-weed, *Spirogyra* and other Algae, also dried liver, were given as food. The fowl eggs and bullock's liver were boiled, then grated up and dried in the sun and stored in bottles. A pinch of the rolled oats rubbed up with a pinch of the dried egg was fed to each compartment twice a week, and a pinch of the liver, some *Euchytra* worms and Algae were given about three times a month.

It was observed that the young *Ceratodus* do not grow evenly, some shooting ahead whilst others lag behind. At three months old, of twelve preserved at this date, the largest was 40 mm. and the smallest 23 mm.; the lengths were: 40, 35, 31, 30, 30, 29, 29, 28, 28, 26, 26, 23 mm. At five months the largest of eighteen was 44 mm. and the smallest 26 mm.; the lengths were: 44, 43, 41, 40, 40, 36, 36, 35, 35, 35, 35, 35, 33, 32, 29, 28, 26 mm. At eight months the largest of twenty-five was 55 mm. and the smallest 26 mm.; the lengths were: 55, 55, 53, 52, 49, 47, 45, 44, 44, 43, 41, 41, 41, 41, 40, 40, 38, 37, 35, 35, 32, 31, 30, 27, 26 mm. At ten months the largest of seventeen was 62 mm. and the smallest 40 mm. At twelve months, of nineteen preserved at this date, the largest was 72 mm. and the smallest 33 mm.

It would be interesting to know what is the cause of the different rates of growth. In-breeding might have something to do with it; the robust larvae may be from parents well mated, whereas the puny larvae may be the progeny of sisters and brothers. Possibly sex might account for it, yet there is no disparity in size between the sexes in aged fish, very large specimens up to eighty pounds in weight of both sexes having been taken.

In past work on the embryology of *Ceratodus*, investigators have mentioned length of the larvae irrespective of age. This may have led to erroneous conclusions. Take for instance one of my three months larvae at 35 mm. and a 35 mm. larva from the five months lot and one of 35 mm. from the eight months series: these, although of the same length, would show different development.

Of three juveniles preserved when two years and three months old, the lengths were 181 mm., 153 mm. and 150 mm., and the weights in gms. 40.8, 22.4 and 17.0. Of four, two years and nine months old, the largest was 262 mm. long and the smallest 175 mm. One preserved when five years old was 16 $\frac{3}{4}$  inches in length (420 mm.) and weighed 16 oz. (454 gms.).

I am indebted to Mr. E. C. Speering, contractor, for preparing a sketch and detailed specifications of the hatchery.